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COLLECTING MACROINVERTEBRATES IN A POLLUTED STREAM USING ROCK-FILLED SAMPLERS

William T. Mason, Jr., et al

Federal Water Pollution Control Administration
Cincinnati, Ohio

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U. S. DEPARTMENT OF THE INTERIOR
Federal Water Pollution Control Administration
1014 Broadway
Cincinnati, Ohio 45202

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Collecting Macroinvertebrates in a Polluted Stream Using Rock-Filled Samplers

by

William T. Mason, Jr., R. Douglas Kreis,
William C. Johnson, and J. B. Anderson

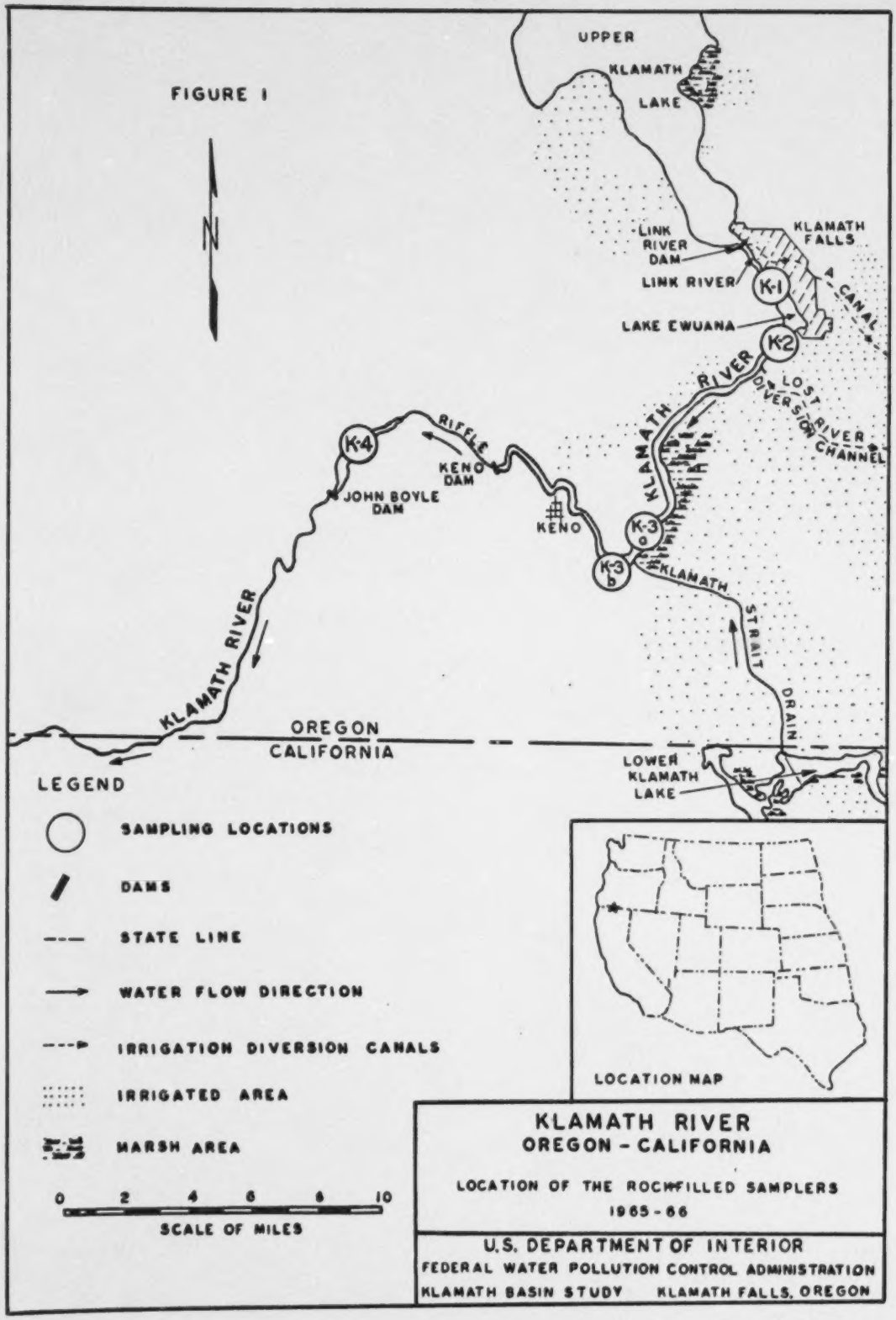
Introduction

Artificial substrate samplers have been found to collect a large number and variety of benthic organisms in large streams (Scott, 1958, Cauthron, 1961). Rock-filled samplers for collecting benthic macroinvertebrates were developed by the Water Pollution Surveillance System in 1964. Macroinvertebrates inhabit the sampler for food, protection, and a suitable substrate. Examples are: those that cling (mayflies and stoneflies); those that attach themselves (certain caddisflies and midges); colonial forms (coelenterates and bryozoans); omnivores (snails and crayfish); predators (odonates and true bugs); scavengers (leeches and aquatic sowbugs); those requiring sediment (oligochaetes and bloodworms); and those finding shelter (scuds). Rock-filled samplers were installed at five locations in the Klamath River, Oregon, to determine their usefulness for biologically evaluating water quality conditions in a stream polluted by domestic sewage, log-pond storage wastes, tallow rendering plant wastes, and agricultural wastes.

Description of Area Studied

The Klamath River (Figure 1) flows 253 miles through southcentral Oregon and northwestern California to the Pacific Ocean. The river has

FIGURE 1



KLAMATH RIVER
OREGON - CALIFORNIA

LOCATION OF THE ROCK-FILLED SAMPLERS
1965 - 66

U.S. DEPARTMENT OF INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMINISTRATION
KLAMATH BASIN STUDY KLAMATH FALLS, OREGON

its origin in the eutrophic Upper Klamath Lake which is located on a semi-arid plateau (elevation 4,100 feet). The lake is approximately 35 miles long, five miles wide, and nine feet deep and is impounded by the Link River Dam. Water draining from Upper Klamath Lake flows about one mile through the Link River to Lake Ewauna. This lake is merely a widened portion of the river two miles long and approximately six feet deep. The City of Klamath Falls is situated on the east bank of Lake Ewauna and the Link River. The lake then narrows forming the Klamath River which is contained by a diked channel approximately 750 feet wide and eight feet deep. This reach of river extends southwest to Keno Dam, 17 miles downstream from Klamath Falls. Irrigation return water transporting agricultural wastes from the Lost River system enters the Klamath River through the Klamath Strait Drain 14 miles downstream from the Link River Dam.

The water in the Klamath River from Lake Ewauna to the Keno Dam is maintained at a constant level throughout the year. Below Keno Dam, the river is aerated by riffles as it descends 240 feet in five miles into a nine mile long reservoir retained by the John C. Boyle Dam. The river then cascades through canyons with a drop of 100-200 feet per mile to the Pacific Ocean.

Station Locations:

K-1 (River Mile 252)	At the mouth of the Link River on Lake Ewauna 1.0 mile downstream from the Link River Dam; upstream from domestic and industrial waste discharges but subjected to enriched water from Upper Klamath Lake (see Figure 2).
K-2 (River Mile 249.5)	0.5 mile downstream from Lake Ewauna; subjected to domestic and industrial wastes (lumber processing, log-pond storage, and tallow rendering wastes (see Figure 2).
K-3a (River Mile 239.5)	On northwest side of the river; not influenced by the Klamath Strait Drain which transports irrigation return water from the Lost River.
K-3b (River Mile 239.5)	On southeast side of the river 200 yards downstream from the Klamath Strait Drain discharge.
K-4 (River Mile 221.5)	In reservoir 2.5 miles upstream from John C. Boyle Dam.

Methods and Materials

The rock-filled sampler initially used for this study was an eight-inch, handmade, cubical frame covered with hardware cloth (Henson, 1965). In 1966 the cubical sampler was replaced by a chromium-plated, welded-wire, cylindrical basket[1] (Figure 3) seven inches in diameter and eleven inches in length because it was less expensive ($2.00 total cost per sampler), more corrosion resistant, and was commercially available (Mason, et al., 1967). Both samplers contained approximately 0.2 cubic feet of one to three-inch limestone or native basalt. The samplers were suspended from stationary

[1] Manufactured by the Hewitt Manufacturing Company, National City, California (Model EZ-50 Tumbler Basket): Mention of commercial sources does not constitute endorsement by the Federal Water Pollution Control Administration.

Figure 2. Upper: In the left foreground is an aerial view (looking north to south) of Klamath Falls, Oregon, and Lake Ewauna showing log storage. The Link River is in the right foreground and the Klamath River is in the right background. Lower: 0.5 mile downstream from Lake Ewauna showing extensive log flotation.

Reproduced from best available copy.

structures by 1/8-inch wire cable to a water depth of 18 to 48 inches for a month's duration. All of the samplers were at least eight inches above the bottom, and in the productive euphotic zone. Collections from each sampling location indicated that there was little difference in the number and variety of macroinvertebrates collected by either sampler or type of rock.

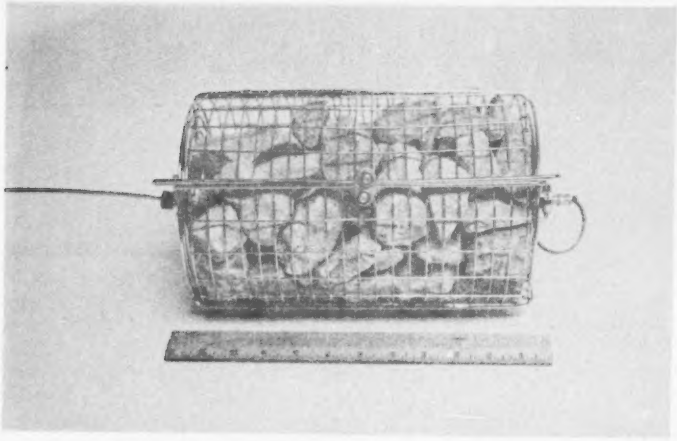


Figure 3. The rock-filled sampler.

The rock-filled sampler has many desirable features for the collection of macroinvertebrates for water pollution studies. It provides a uniform substrate for the attachment of benthic organisms regardless of its location. The samplers contain approximately equal amounts of substrate material, thus permitting a general comparison of the number and species collected at the stations.

The cylindrical basket is durable, and the weight (20 lbs.) prevents vertical displacement in a stream. The sampler can be installed and serviced by most anyone familiar with the sampling objectives.

The collection procedure consisted of emptying the rocks into a tub partially filled with water and brushing each rock with a stiff-bristled brush to remove the organisms. The samples were concentrated in a U. S. Number 30 sieve and preserved in 70% ethanol or 7% formalin.

In the laboratory, the samples were rinsed in a U. S. Number 40 sieve. The organisms were sorted from the debris, counted, and identified. The counts were expressed as numbers of individuals and kinds per sampler. Samples containing a large number of organisms were subdivided to reduce time of sorting, counting, and identification. In 1966 some samples were stained with rose bengal to facilitate sorting (Mason and Yevich, 1967).

Results and Discussion

In Table I the number of organisms collected at five sampling locations in the Klamath River, Oregon, during the summer of 1965 and 1966 are enumerated. The minimum number was 44 collected in September 1965 at Station K-3b. The maximum number was 7120 collected in July 1965 at Station K-1. The number of midges collected during August and September 1966 showed a considerable increase over those collected in 1965 during the same months. The most prevalent organisms occurring in the samplers during 1965 and 1966 were midges, odonates, amphipods, leeches, and snails. The number of worms fluctuated greatly and showed no particular pattern of occurrence.

Eighty-two kinds of organisms representing 18 orders were collected from the rock-filled samplers in the Klamath River during 1965 (Table II). The midges (Diptera:Chironomidae) collected from the Klamath River that are capable of withstanding extended periods of low dissolved oxygen were Procladius sp. (Carr and Hiltunen, 1965), the bloodworms Chironomus (Chironomus) attenuatus (Curry, 1965), C. (Chironomus) utahensis (Bonnell and Mote, 1942), and Glyptotendipes (Phytotendipes) lobiferus (Paine and Gaufin, 1956).

Macroinvertebrates which comprise a majority of the benthic fauna in marginal zones of organic pollution (Hynes, 1963) include the scud Gammarus sp., the aquatic sowbug Asellus sp., the leech Helobdella stagnalis, and pulmonate snails. These invertebrates were collected at all stations except for Asellus which was not found at Station K-4. Few caddisflies and stoneflies were collected during the course of this study.

Mayflies collected in significant numbers in the samplers were Caenis and Tricorythodes which according to Pennak (1953) inhabit sluggish, heavily silted rivers. The mayflies Callibaetis and Caenis were collected at every station. Gaufin and Tarzwell (1952) reported Callibaetis occurring in a zone of moderate organic pollution during a study of Lytle Creek, Ohio.

The exceptionally large number (sometimes over 5,000 organisms per sampler) and diversity of organisms collected at Station K-1

reflects the highly enriched water draining from the eutrophic Upper Klamath Lake (Table I and Figure 5). This was the only station that caddisflies and mayflies appeared consistently in the samplers during 1965 and 1966. The fauna was characterized by a large percentage of midges, oligochaetes, and scuds (Figure 4).

The most affected reach of the river by domestic, industrial, and log pond storage wastes was in the vicinity of Station K-2. During August, September, and October 1965, "pollution-tolerant" bloodworms were the most prevalent organisms in the sampler, comprising 64% of the total population (Figure 4). Few caddisflies or mayflies were collected in 1965 and were entirely absent in 1966. The most severe effects of pollution on the benthos occurred in October 1965 when 2,488 organisms were represented by only eight species, four of which were bloodworms. In this sample the oligochaetes and bloodworms comprised 86% of the individuals collected (Figure 5).

A large fish kill (approximately 300,000 chubs) occurred in the vicinity of Station K-3a during mid-August 1966. Dissolved oxygen concentration ranged from nondetectable values to maximum values of 1.4 mg/l at the surface and 0.9 mg/l at the bottom through September. In August, 1,158 midge larvae were collected as contrasted to 13 in September, and none in October. The drastic decline of midge larvae was apparently due to products of organic decomposition and associated low dissolved oxygen. The Oligochaetes (worms) increased dramatically in numbers at

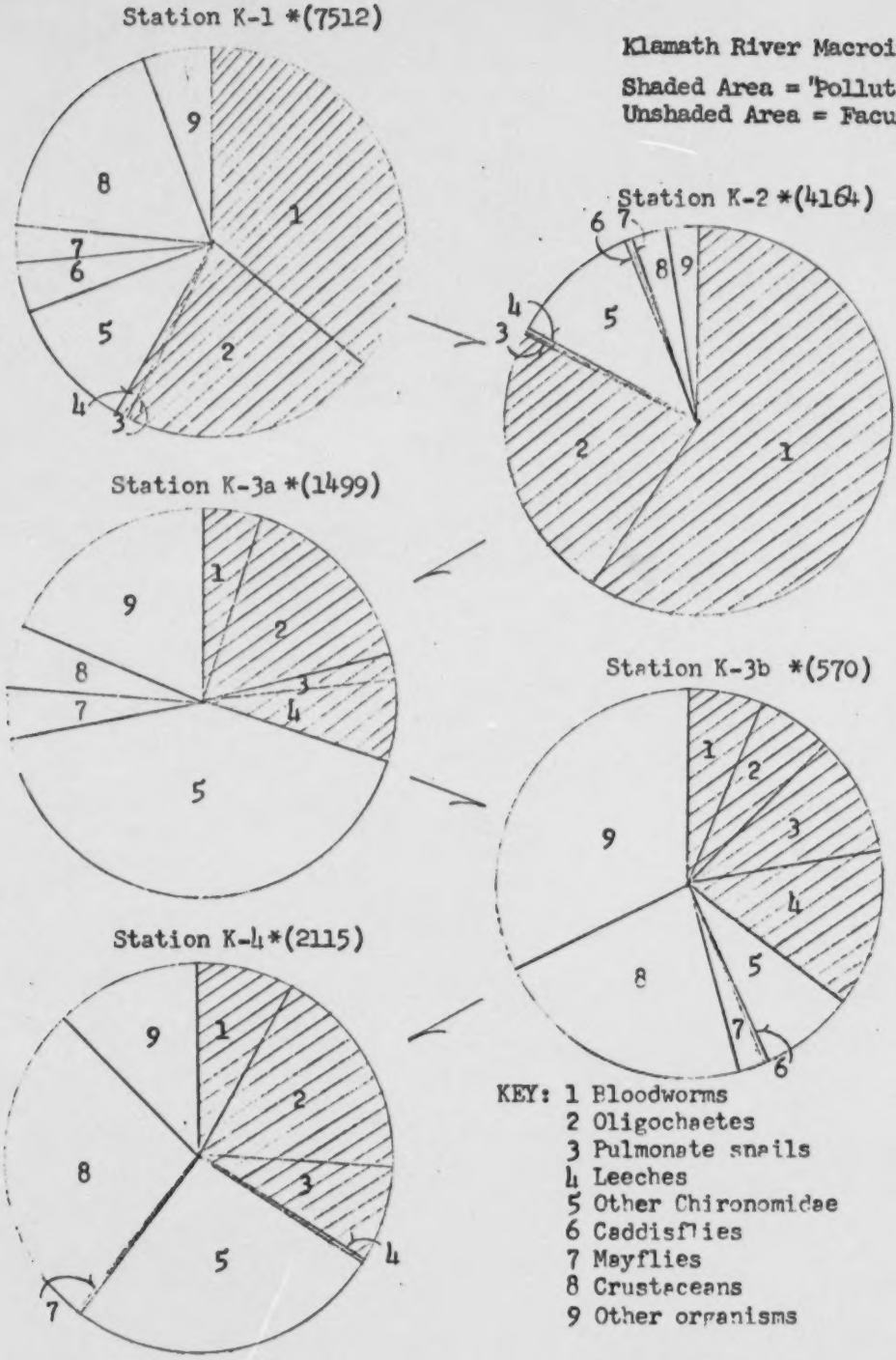


Figure 4. Composition of the total fauna expressed as "pollution tolerant"and facultative organisms collected during August, September, and October 1965 from rock-filled samplers in the Klamath River, Oregon.

*Total individuals for the three months

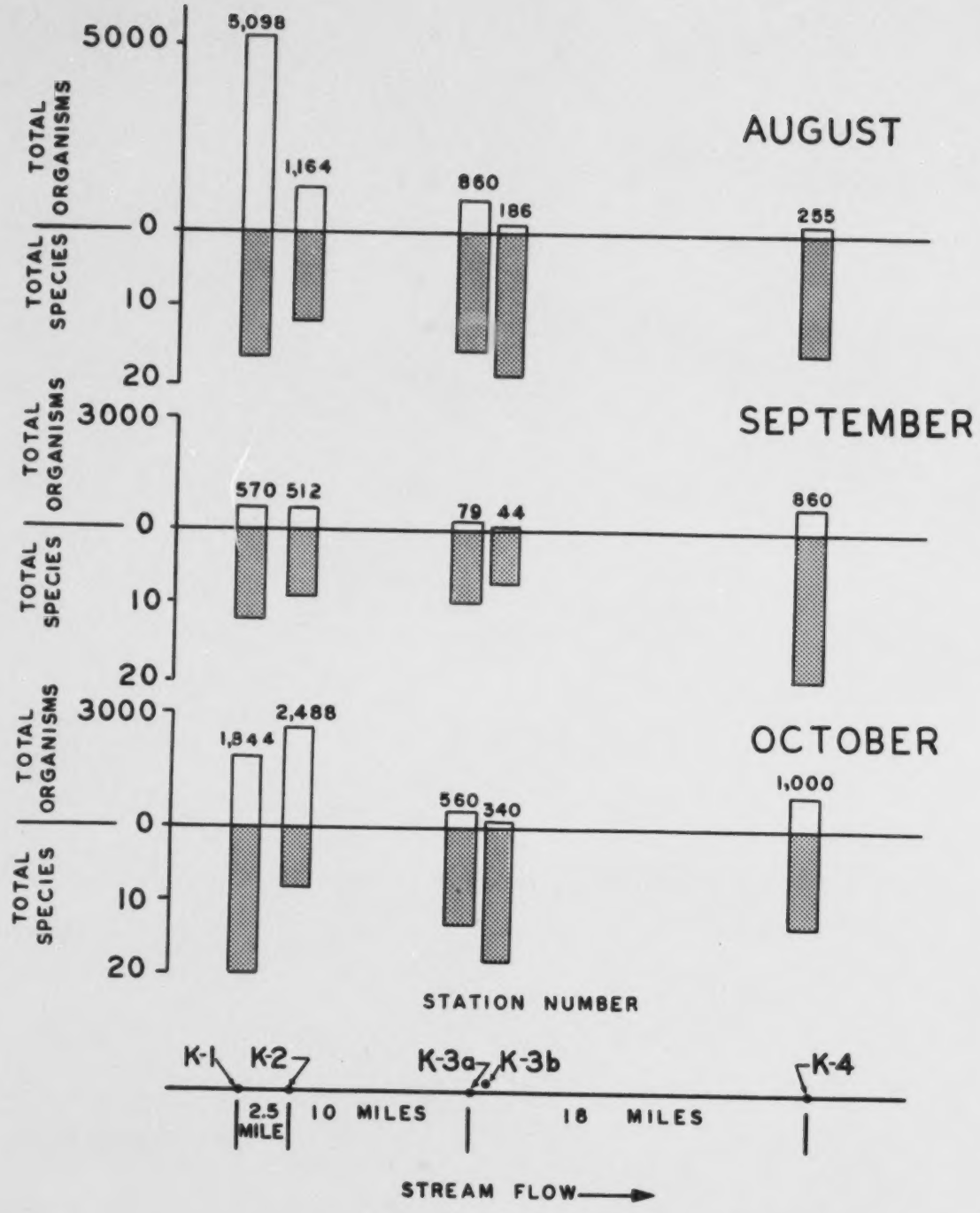


Figure 5. Numbers of organisms and species collected from rock-filled samplers, Klamath River, Oregon, August, September, and October 1965.

both K-3a and K-3b during this period. Small numbers of mayflies were collected at the K-3a station during the summer of 1965 and July 1966, but none were found during the periods of low dissolved oxygen (Table I).

Station K-3b was immediately downstream from the irrigation return water discharge of the Klamath Strait Drain. The agricultural waste water transports considerable amounts of organic material and silt from the Lost River system which settles rapidly upon entering the Klamath River due to a decrease in the velocity. However, this drainage, which is aerated by pumping, usually increases the level of dissolved oxygen in the Klamath River at Station K-3b during the summer months. In 1965, 43 species were collected at this station compared to 34 species at Station K-3a which is directly across the stream and not affected by the drain (Table II). The larger diversity at K-3b of mayflies, beetles, and clams was due to the dilution of the Klamath River by aerated water coming from the Klamath Strait Drain. In 1966, during the period of low dissolved oxygen, the populations at Stations K-3a and K-3b were composed primarily of "pollution-tolerant" organisms such as worms, leeches, and pulmonate snails. These data indicated that during the summer of 1966 the dilution water from the Klamath Strait Drain had little effect on improving low dissolved oxygen concentrations in the Klamath River.

Station K-4 is located in a reservoir that receives water aerated by riffles. Forty-two percent of the species collected at Station K-4 in 1965 were midge larvae (Figure 4). The most prevalent midges were larvae of Tanytarsus spp. The only species of leech collected was Helobdella stagnalis, whereas four to five species were collected at the other stations. The absence of caddisflies was quite noticeable and was possibly due to a lack of current. Although the kinds and number of macroinvertebrates collected at Station K-4 did indicate some improvement of water quality, there was not substantial improvement for the development of a diversified benthic population during the summer months.

Conclusions

1. The largest number and diversity of macroinvertebrates collected from rock-filled samplers at five locations in the Klamath River, Oregon, 1965-66 were at the Link River, immediately downstream from the eutrophic Upper Klamath Lake and upstream from major waste sources.
2. During August, September, and October 1965, "pollution-tolerant" bloodworms and oligochaetes comprised over 75% of the invertebrates collected in the immediate vicinity of waste discharges at the city of Klamath Falls.
3. In 1966 adverse effects of pollution on the macroinvertebrate fauna became more severe near Klamath Falls and extended ten miles downstream from the area of waste discharges. The combined factors of low water, wastes, and insufficient dissolved oxygen eliminated caddisflies, mayflies, and sensitive midges, and permitted large populations of "pollution-tolerant" organisms to develop in the samplers.
4. A large number and variety of macroinvertebrates were collected in the Klamath River as evidenced by the following summary data:

   Maximum number of organisms per sampler - 7,000 Station K-1 (July 1965)

   Minimum number of organisms per sampler - 44 Station K-3b (September 1965)

   Average number of organisms per sampler, 1965-66 - 1,900

   Kinds of organisms identified at all stations, 1965 - 82
5. This study shows that in a stream adversely affected by domestic, industrial, and agricultural wastes, different zones of pollution can be determined by the use of macroinvertebrate collections from rock-filled samplers.

Table I. Benthic Macroinvertebrates Collected During the Summer of 1965 and 1966 in the Rock-Filled Sampler, Klamath River, Oregon

	1965				1966			
Station K-1	July	Aug.	Sept.	Oct.	July	Aug.	Sept.	Oct.
Organisms:								
Diptera (True flies)								
Chironomidae (Midges)	3552	2958	330	380	980	5576	2108	200
Other			4	24		4		
Trichoptera (Caddisflies)	16	4	72	280	4	44	272	328
Plecoptera (Stoneflies)								
Ephemeroptera (Mayflies)		168	36	64		16	116	36
Odonata (Dragon & Damselflies)		80	4	8			16	4
Hemiptera (True bugs)								
Coleoptera (Beetles)	8					4		
Lepidoptera (Aquatic moths)								
Amphipoda (Scuds)	312	1136	112	84	108	128	156	136
Isopoda (Sowbugs)	112	32	12	32	8	12	92	28
Oligochaeta (Worms)	3000	640		932	64		180	1072
Hirudinea (Leeches)	16	72		4	44	8	12	4
Turbellaria (Planarians)	72			12	20	64	76	28
Pelecypoda (Clams)								
Gastropoda (Snails)	32	8		24	8	72	44	28
Bryozoa (Moss animals)	X							
Coelenterata (Hydras)	X			X				X
Porifera (Sponges)								X
Total Individuals	7120	5098	570	1844	1236	5928	3072	1864
Station K-2								
Organisms:								
Diptera (True flies)								
Chironomidae (Midges)	1653	1024	440	1484	272	5416	1674	956
Other		4						
Trichoptera (Caddisflies)				20				
Plecoptera (Stoneflies)								
Ephemeroptera (Mayflies)			4					
Odonata (Dragon & Damselflies)		4			2			12
Hemiptera (True bugs)						16		
Coleoptera (Beetles)								
Lepidoptera (Aquatic moths)					1			
Amphipoda (Scuds)	32	12	32	28	8	8	4	16
Isopoda (Sowbugs)	250	64	16	12	116	32	456	292
Oligochaeta (Worms)		40		944	123			80
Hirudinea (Leeches)	28	4	20		152	24	32	308
Turbellaria (Planarians)					140	8		
Pelecypoda (Clams)								
Gastropoda (Snails)	68	12			65	48		12
Bryozoa (Moss animals)								
Coelenterata (Hydras)								
Porifera (Sponges)								
Total Individuals	2031	1164	512	2488	879	5552	2166	1676

continuation of

Table I. Benthic Macroinvertebrates Collected During the Summer of 1965 and 1966 in the Rock-Filled Sampler, Klamath River, Oregon

Station K-3a	1965 July	1965 Aug.	1965 Sept.	1965 Oct.	1966 July	1966 Aug.	1966 Sept.	1966 Oct.
Organisms:								
Diptera (True flies)								
Chironomidae (Midges)	750	676	5	44	648	1158	13	
Other	4					1		
Trichoptera (Caddisflies)								
Plecoptera (Stoneflies)								
Ephemeroptera (Mayflies)	8	4	2	64	12			
Odonata (Dragon & Damselflies)	68	64	44	96	8			24
Hemiptera (True bugs)		4						
Coleoptera (Beetles)					4	10		
Lepidoptera (Aquatic moths								
Amphipoda (Scuds)	704	60	7	12	56			
Isopoda (Sowbugs)				8	4	13	9	
Oligochaeta (Worms)				240	368	55	168	1436
Hirudinea (Leeches)	116	36	17	56		172	227	256
Turbellaria (Planarians)					8			
Pelecypoda (Clams)								
Gastropoda (Snails)	36	16	4	40	184	6		56
Bryozoa (Moss animals)	X	X						
Coelenterata (Hydras)								
Porifera (Sponges)								
Total Individuals	1686	860	79	560	1292	1415	417	1772
Station K-3b								
Organisms:								
Diptera (True flies)								
Chironomidae (Midges)	835	2	1	80	1660	228	73	4
Other								
Trichoptera (Caddisflies)		1		2				
Plecoptera (Stoneflies)								
Ephemeroptera (Mayflies)	2	2		10				
Odonata (Dragon & Damselflies)	20	20	17	104	12		4	12
Hemiptera (True bugs)	8					1	2	
Coleoptera (Beetles)	1	1			4			
Lepidoptera (Aquatic moths								
Amphipoda (Scuds)	495	74		40	1036	2	1	8
Isopoda (Sowbugs)	8	7		8	20	88	12	12
Oligochaeta (Worms)	8			36		28	1431	4284
Hirudinea (Leeches)	576	58	1	16	524	320	255	240
Turbellaria (Planarians)						3		
Pelecypoda (Clams)				44			1	
Gastropoda (Snails)	28	21	25		600	12	45	68
Bryozoa (Moss animals)	X	X				X		
Coelenterata (Hydras)		X		X				
Porifera (Sponges)								
Total Individuals	1981	186	44	340	3856	682	1824	4628

continuation of

Table I. Benthic Macroinvertebrates Collected During the Summer of 1965 and 1966 in the Rock-Filled Sampler, Klamath River, Oregon

Station K-4	1965 July	1965 Aug.	1965 Sept.	1965 Oct.	1966 July	1966 Aug.	1966 Sept.	1966 Oct.
Organisms:								
Diptera (True flies)								
Chironomidae (Midges)		72	668	96	600	2568		
Other								
Trichoptera (Caddisflies)								
Plecoptera (Stoneflies								
Ephemeroptera (Mayflies)		7		8		8		
Odonata (Dragon & Damselflies)		64	36	88	28	32		
Hemiptera (True bugs)								
Coleoptera (Beetles)		3						
Lepidoptera (Aquatic moths)	No Sample						No Sample	No Sample
Amphipoda (Scuds)		14	128	388	12	8		
Isopoda (Sowbugs)					4			
Oligochaeta (Worms)		20		340		560		
Hirudinea (Leeches)		2			12	8		
Turbellaria (Planarians)			4		56	24		
Pelecypoda (Clams)								
Gastropoda (Snails)		73	24	80		64		
Bryozoa (Moss animals)					X	X		
Coelenterata (Hydras)			X	X				
Porifera (Sponges)								
Total Individuals		255	860	1000	712	3272		

Table II. Benthic Macroinvertebrates Collected from Rock-Filled Samplers in the Klamath River, Oregon-California, 1965

Stations and River Miles	K-1, Klamath Falls (RM 252)	K-2, Big K Mill (RM 249.5)	K-3a, Teeters Landing-NW (RM 239.5)	K-3b, Teeters Landing-SE (RM 239.5)	K-4, Boyle Dam (RM 221.5
Organisms					
Diptera (True flies)					
Chironomidae (Midges)					
Tanypodinae					
Ablabesmyia sp. Joh.	X				X
Procladius (Procladius) sp. Skuse		X			
Orthocladiinae					
Orthocladius sp. Wulp					X
Crocotopus sp. Wulp	X				
C. trifasciatus (Panzer)		X	X		
C. exilis Joh.	X				
C. bicinctus (Meigen)					X
Psectrocladius sp. Kieffer	X	X			X
Nanocladius sp. ? Kieffer		X	X	X	X
Cardiocladius obscurus (Joh.)	X				
Corynoneura scutellata Winnertz					X
Chironominae					
Chironomus (Chironomus) attenuatus Walk.	X	X	X	X	X
C. (Chironomus) utahensis Malloch		X		X	
C. (Dicrotendipes) sp. Kieffer	X	X	X	X	
C. (Dicrotendipes) modestus Say					X
C. (Dicrotendipes) nr. fumidus Joh.			X	X	
C. (Einfeldia) sp. (Kieffer)	X			X	X
C. (Cryptochironomus) abortivus Mall.	X	X	X	X	X
Glyptotendipes (Glyptotendipes) sp. Kieff.	X	X	X	X	X
G. (Phytotendipes) sp. nr. polytomus	X	X		X	X
G. (Phytotendipes) lobiferus (Say)	X	X	X	X	X
Tanytarsus (Tanytarsus) sp. Wulp					X
T. (Cladotanytarsus) sp. Kieffer					X
T. (Calopsectra) sp. Kieffer	X				X
Stempellina (sp. A Joh.)	X				
Micropsectra sp. Kieffer	X	X	X		

continuance of
Table II. Benthic Macroinvertebrates Collected from Rock-Filled Samplers in the Klamath River, Oregon-California, 1965

Stations and River Miles	K-1	K-2	K-3a	K-3b	K-4
Organisms:					
Diptera (continued)					
Ceratopogonidae (Biting Midges)					
Palpomyia sp. Meigen				X	
Bezzia sp. Kieffer			X		
Simuliidae (Blackflies)					
Simulium sp. Latreille	X	X			X
Trichoptera (Caddisflies)					
Hydropsychidae					
Hydropsyche sp. Pictet	X	X		X	
Psychomyiidae					
Polycentropus cinereus Haggen				X	
Leptoceridae					
Mystacides sp. Berthold	X				
Limnephilidae					
Limnephilus sp. Leach	X				
Phryganeidae					
Agrypnia sp. Hagen			X	X	
Hydroptilidae					
Agraylea sp. Curtis	X				
Ephemeroptera (Mayflies)					
Caenidae					
Caenis sp. Stephens	X	X	X	X	X
Tricorythodes fallax Traver	X			X	X
Baetidae					
Baetis sp. Leach	X	X		X	
Callibaetis sp. Eaton	X	X	X	X	X
Ephemerella mollita ? Seemann		X			
Odonata					
Anisoptera (Dragonflies)					
Aeshna sp. Fabricius		X	X	X	X
Anax sp. Leach			X	X	X
Zygoptera (Damselflies)					
Ischnura sp. Charpentier	X	X	X	X	X
Enallagma sp. Charpentier	X		X	X	X
Argia sp. Rambur	X	X			X
Hempitera (True bugs)					
Corixidae					
Corisella inscripta (Uhler)			X	X	

continuance of
Table II. Benthic Macroinvertebrates Collected from Rock-Filled Samplers in the Klamath River, Oregon-California, 1965

Stations and River Miles	K-1	K-2	K-3[a]	K-3[b]	K-4
Organisms:					
Coleoptera (Beetles)					
Elmidae					
Optioservus sp. Sanderson	X				
Dytiscidae					
Laccophilus sp. Leach					X
Haliplidae					
Haliplus sp. Latreille				X	X
Brychius sp. Thomson				X	
Gyrinidae					
Gyrinus sp. Müller	X				
Lepidoptera (Aquatic moths)					
Parargyractis sp. Lange	X	X			
Crustacea					
Amphipoda (Scuds)					
Hyalella azteca (Saussure)	X	X	X	X	X
Gammarus sp. Fabricius	X	X	X	X	X
Isopoda (Sowbugs)					
Asellus sp. Geoffrey	X	X	X	X	
Oligochaeta (Worms)					
Naididae					
Nais sp. Müller		X			
Stylaria lacustris (L.)	X	X		X	X
S. fossularis Leidy	X	X			
Ophidonais serpentina (Müller)		X	X	X	X
Lumbriculidae	X				
Tubificidae		X	X	X	
Hirudinea (Leeches)					
Glossophonidae					
Glossophiona complanata (L.)	X	X	X	X	
Helobdella stagnalis (L.)	X	X	X	X	X
Theromyzon sp. Philippi			X		
Erpobdellidae					
Erpodbella annulata (Moore)	X	X	X	X	
Dina parva Moore	X	X			
Mooreobdella sp. Pawlowski				X	
Piscicolidae					
Pisciola gometra (L.)	X	X			

continuance of

Table II. Benthic Macroinvertebrates Collected from Rock-Filled Samplers in the Klamath River, Oregon-California, 1965

Stations and River Miles	K-1	K-2	K-3a	K-3b	K-4
Organisms:					
Turbellaria					
Planariidae (Planarians)	X	X		X	X
Nematoda (Roundworms)	X	X			
Mollusca					
Gastropoda (Snails)					
Physidae					
Physa sp. Draparnaud			X	X	
Planorbidae					
Helisoma sp. Swainson			X	X	
Gyraulus sp. Charpentier	X	X	X	X	X
Parapholyx sp. Hanna		X		X	
P. klamathensis	X	X	X	X	X
Amnicolidae					
Fluminicola sp. Stimpson	X				X
Lymnaeidae					
Lymnaea (Stagnicola) sp. Jeffreys			X	X	X
Valvatidae					
Valvata sp. Müller	X	X	X	X	X
Bulimidae					
Pyrgulopsis sp. ? Call and Pilsbry	X				
Lancidae					
Lanx sp. Clessin	X	X			
Ancylidae					
Ferrissia sp. Walker					X
Pelecypoda (Clams)					
Sphaeridae					
Sphaerium sp. Scopoli			X	X	
Bryozoa (Moss animals)					
Plumatellidae					
Plumatella sp. Lamarck	X		X	X	
Coelenterata (Hydras)					
Hydra sp.	X	X	X	X	X
*Total Species	48	38	34	43	38

*Excluding the Oligochaeta
X = Present

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